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(54) Tool exchange system for hybrid die bonder.

(57) A tool exchange system for a hybrid die bonder, in particular an automatic hybrid die bonder, comprises a head (14) which is adapted to pick up a selected tool holder (40) fitted with a tool (48), from a tool bank comprising a plurality of tool holders. The tool holder (40) and head (14) are fitted with co-operating centering means for precise positioning of the tool holder (40) on the head (14).

The system further comprises means for driving the head between the tool bank, a die eject station of the hybrid die bonder and a mounting station, and means for indexing the tool bank to index a selected tool holder (40) to a station at which it can be picked up by the head (14).

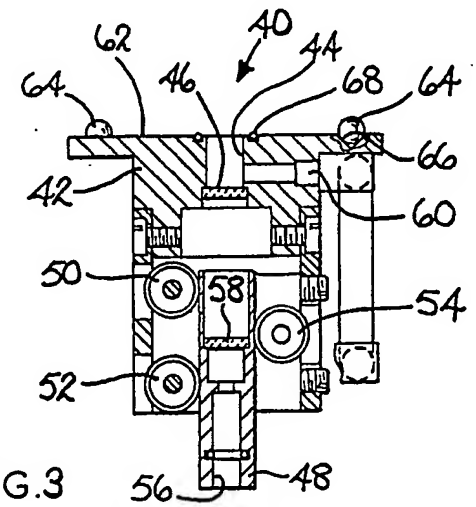

FIG.3

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The present invention relates to a tool exchange system for a die pick-up stage of a hybrid die bonder, in particular an automatic hybrid die bonder.

A hybrid die bonder is used for bonding semiconductor dice of a range of different types, and in particular, sizes to a substrate. The die is supplied in an appropriate die presentation system, a number of different types of which are known and used, to a die eject station, at which individual dice are ejected from the die presentation system and picked up by an appropriate tool.

In known pick-up systems, the pick-up tool comprises one or more pairs of jaws held in a holder fixed in the machine. When it is necessary to change from picking up one size of die to picking up a different size of die, in known machines, the tool jaws are changed. This has the disadvantage that there is a loss in operating time while the jaws are being changed, and the exact position and orientation of the jaws relative to a fixed reference point has to be determined on each occasion that the jaws are changed.

It is a further disadvantage of the known machines, which is particularly significant when small dice are being handled, that the effective weight of the tool assembly is quite high, which makes fine adjustment of the die more difficult.

It is an object of the present invention to provide a tool exchange system for a die pick-up stage of a hybrid die bonder, in particular an automatic hybrid die bonder, in which the above disadvantages are reduced or substantially obviated.

An automatic hybrid die bonder, as shown in Figure 1, comprises a die presentation system, shown generally at 102, a die eject station shown generally at 104 and a die pick up and mounting system, which may be a die collet system (106) or an epoxy print system (108), according to the present invention. A suitable die presentation system (102) is described and claimed in our copending UK Patent Application (Folio 15095) of even date herewith, and comprises a magazine (110) for storing a plurality of die presentation packages (112), a rotatable clamp assembly (114) comprising front and second clamp means (116,118) mounted on a rotatable support and each adapted to collect a selected die presentation package from the magazine (110), feed it to the die eject station (104), retrieve it from the die eject station after a predetermined number of dice have been ejected and return it to said magazine (110). The die presentation system (102) further comprises indexing means for indexing movement of the packages within the magazine (110) so that the selected package is located at a collection point for collection from the magazine.

The die presentation package is then fed to a die eject station (104) which suitably comprises a die eject system such as the die eject system described and claimed in our copending UK Patent Application (F.15094) of even date herewith, which system comprises a support, a plurality of die eject leads mounted on the support, and means for indexing movement of the support to index a die eject head into an operative position. The different die eject heads comprise different arrangements of die eject needles, each of which is suitable for ejecting a particular size or type of die.

After ejection at the die eject station (104), the die is picked by a suitable pick up and taken to a die mounting station. An automatic hybrid die bonder preferably comprises both a die collet mounting station (106) and a epoxy die bonding station (108). The die pick-up stage suitably comprises a tool exchange system according to the present invention.

The present invention provides a tool exchange system for a hybrid die bonder, which system comprises

(a) a support

(b) a head mounted on the support

(c) a tool bank comprising a plurality of tool holders each fitted with a tool, and adapted for pick-up by the head (b)

(d) co-operating centering means on the tool holder and head (b) for precise positioning of the tool holder on the head

(e) means for driving the head between the tool bank (b), a die eject station of the hybrid die bonder and a mounting station and

(f) means for indexing the tool bank (b) to index a selected tool holder to a station at which it can be picked up by the head (b).

The tool bank (c) preferably contains a plurality of tool holders, each of which is fitted with a differently sized tool. The tool holders may be arranged in a linear bank or may be spaced, preferably equiangularly for rotation about an axis.

The tool holder is preferably held on the head (b) by means of an electromagnet.

A preferred embodiment of a tool exchange system for a die pick-up stage of a hybrid die bonder according to the invention will now be described with reference to the accompanying drawings, in which;

Figure 1 is a general view of an automatic hybrid die bonding machine.

Figure 2 is a view in section of a head assembly with tool holder fitted and

Figure 3 is a view in section, in enlarged scale, of the tool holder in detail.

As can be seen from Figure 2, a head assembly (10) is mounted on a support (12), and comprises a head (14) which comprises a magnet body (16) in which a solenoid (18) is located. A central

bore of cross-section is provided in the head (14), and is in the form of an upper relatively narrow section, which is extended into an area of relatively large cross-section, before terminating in a relatively short, relatively narrow section at the lower part of the head. A photo cell (20) is located within the relatively large section of the bore. A spindle (22) of matching cross section with the bore is located within the upper, relatively narrow section, and extends, with its own relatively large extended portion, into the upper part of the relatively large section. The head (14) is secured to the spindle (22) which is mounted for rotation about a vertical axis. An air or vacuum connection (24) is provided in the head (14) above the solenoid (18) and communicates with the central bore.

A stepping motor (26) is mounted on the support (12), and connected through the support (12) to a first belt drive wheel (28). The first belt drive wheel (28) is connected via a toothed belt (30) to drive a second wheel (32). This second wheel (32) is adapted for driving engagement with the spindle (22) of the head (14). A switch (not shown) is provided to control the position of the spindle (22).

As is shown in more detail in Figure 3, a tool holder (40) comprises a magnetic body (42). The tool holder (40) is provided with a central bore (44) in which a glass plate (46) is located. A tool (48) is located for vertical movement within the tool holder (40), and is guided by grooved bearings (50,52,54). The tool (48) is provided with a central bore (56) in which a second glass plate (58) is located.

An air or vacuum connection (60) is provided in the side wall of the tool holder (40), close to its upper surface (62).

Precise location of the tool holder (40) on the head assembly (10) is achieved by means of a three-point location system. Three spheres (64) are mounted, equiangularly spaced, in the upper surface (62) of the tool holder (40), in recesses (66) machined close to the outer edge of the upper surface. Three matching location points are provided on the lower surface of the head (14), spaced to mate with the spheres (64) when the tool holder (40) is received on the head (14).

The first of these three location points is a concave surface, which determines the x-y position of the tool holder (40) relative to the head (14); the second is a flat surface which determines the height of the tool holder relative to the head and the third is a triangular prism which determines the angular rotation of the tool holder relative to the head. Thus in a simple manner, using a three point positioning system, the x-y position; angular rotation and height of the tool holder relative to the head can be precisely determined, reproducible to an accuracy of a few microns.

In operation, the head assembly (10) is driven to a tool bank, which has itself been indexed to locate a selected tool holder (40) at the pick-up station. The head (14) then picks up the tool holder (40) from the tool bank by means of the solenoid (28). A seal between the head (14) and tool holder (40) is provided by an O-ring (68) provided on the upper surface (62) of the tool holder (40). Precise orientation and location of the tool holder is ensured by the three-point system comprising the spheres (64) and matching location points.

The head assembly, including the tool holder, is then driven to the die eject station (104) of the hybrid die bonder where it is supplied with a semiconductor die by a die eject system as described and claimed in our co-pending GB Patent Application No. (F.15094) of even date herewith. The die is held onto the tool by suction, the tool being evacuated by means of the air-vacuum connection (60).

The complete head assembly is then driven to a mounting station where the die is bonded to a substrate. The photo cell (20) forms part of a light path control system where illumination is carried out through the glass plates (46,58) to ascertain whether or not a die is held on the tool (48). The tool holder is then rotated if necessary, by means of the stepping motor (26) and associated toothed belt (30).

The die is then appropriately mounted and the head assembly either returned to the die eject station, to pick up a further similar die, or to the tool bank for tool exchange.

Claims

1. A tool exchange system for a hybrid die bonder, which system comprises
   (a) a support (12)
   (b) a head (14) mounted on the support (12)
   (c) a tool bank comprising a plurality of tool holders (40) each fitted with a tool (48) and adapted for pick up by the head (14)
   (d) co-operating centering means on the tool holder (40) and head (14) for positioning the tool (40) on the head (14)
   (e) means for driving the head between the tool bank (c), a die eject station of the hybrid die bonder and a mounting station and
   (f) means for indexing the tool bank (c) to index a selected tool holder (40) to a station at which it can be picked up by the head (14)
   characterised in that
   the co-operating centering means (d) comprises a three point location system for precise positioning of the tool holder (40) on the head (14).

2. A tool exchange system according to claim 1, characterised in that the three point location system comprises three spheres (64) mounted, equiangularly spaced, in the upper surface (62) of the tool holder (40), and three matching location points provided on the lower surface of the head (14).

3. A tool exchange system according to claim 2 characterised in that the three location points provided on the lower surface of the head (14) comprise a first location point which is a concave surface, which determines the x-y position of the tool holder (40) relative to the head (14); a second location point which is a flat surface which determines the height of the tool holder relative to the head and a third location point which is a triangular prism which determines the angular rotation of the tool holder relative to the head.

4. A tool exchange system according to any of claims 1 to 3, characterised in that the tool bank (c) contains a plurality of tool holders (40), each of which is fitted with a differently sized tool or die collet (48).

5. A tool exchange system according to any of claims 1 to 4, characterised in that the tool holder (40) is held on the head (14) by means of an electromagnet.

6. A tool exchange system according to any of claims 1 to 5, characterised in that the tool holder (40) is mounted on the head (14) for rotation about a vertical axis.

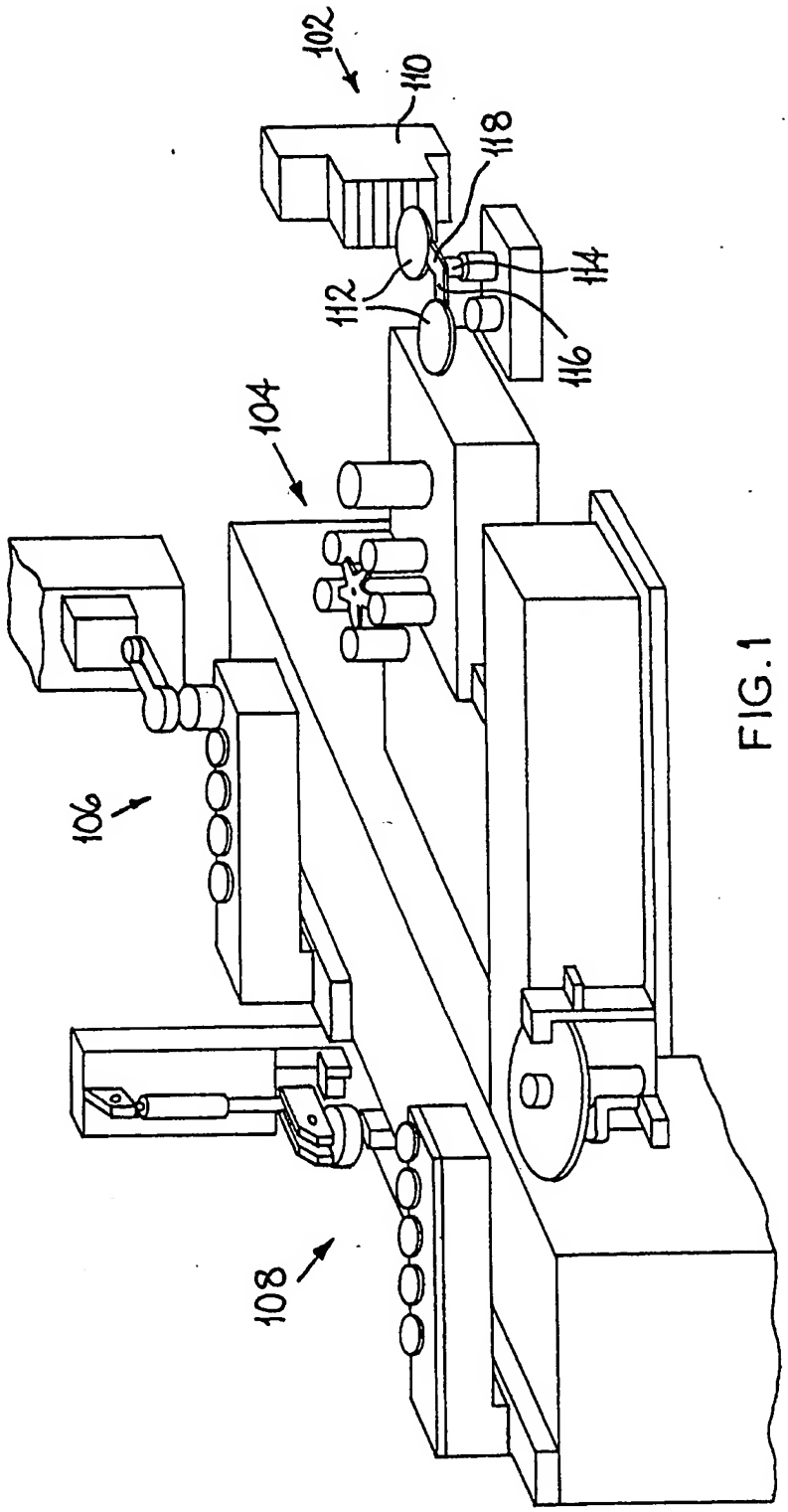
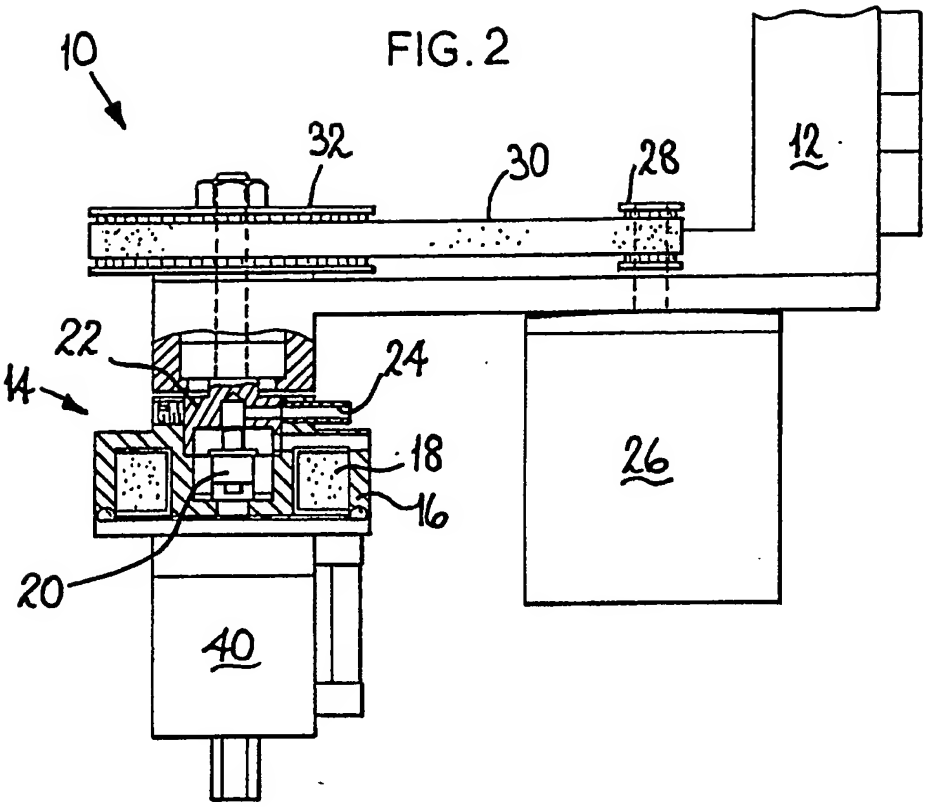


FIG.1

FIG. 2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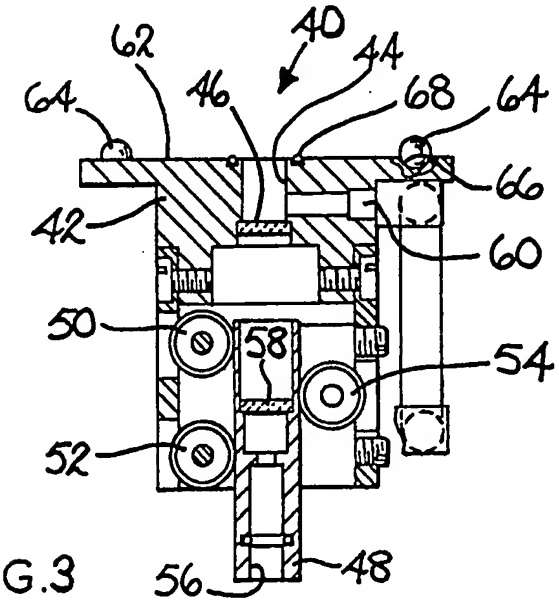
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FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 91301769.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP - A2/A3 - 0 154 552 (DYNAPERT) * Abstract; fig. 1,2; claims 1-7 * --	1	H 05 K 13/00
A	US - A - 4 795 518 (MEINEL) * Abstract; fig. 2 * --	1	
A	US - A - 4 526 646 (SUZUKI) * Abstract; fig. 1-3 * --	1	
A	JP - A - 61-201 431 (TOKYO) * Title; fig. 1 * --	1	
A	JP - A - 01-227 442 (MATSUSHITA) * Title * ----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 05 K 13/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	19-06-1991	VAKIL

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